Relaxation of axially confined 400 GeV/c protons to planar channeling in a bent crystal: Supplementary Material

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For a better description of the process of scattering of the 400 GeV/c proton beam in the field of $\langle 111 \rangle$ axes, we present two animations of the evolution of the deflected beam distributions vs. the penetration depth inside the two tested crystals. A sketch of the strip crystals used in the experiment is shown in Fig. 1. The strip is bent via a mechanical holder that imparts a primary curvature, resulting in a secondary anticlastic curvature. This secondary curvature is used to steer the beam that impinges onto the middle of the crystal (see the big

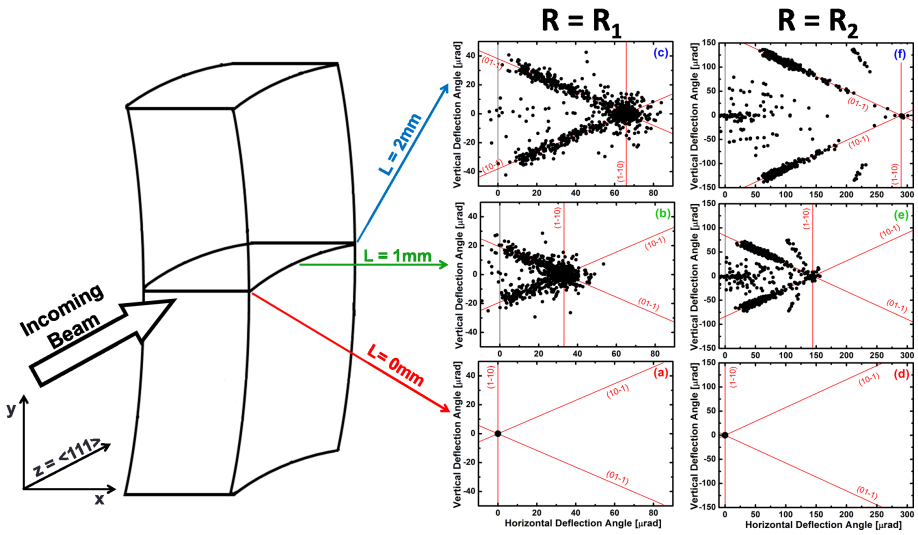

Figure 1: Left: Sketch of the strip crystals used in the experiment. The anticlastic curvature is used to steer the beam that impinges on the crystal entry face (1x55 mm^2) in its center (see the big-arrow direction). Dimension not to scale. Right: Deflected beam distributions for the crystal 1 at the crystal entry face [$L = 0mm$, (a)], in the middle [$L = 1mm$, (b)] and at the crystal exit [$L = 2mm$, (c)]. The same for the crystal 2 are shown in plots (d) [$L = 0mm$], (e) [$L = 1mm$] and (f) [$L = 2mm$], respectively.

arrow in Fig. 1). The two animations have been obtained with the Monte Carlo code used in the paper and show the protons deflection angle in the plane (x,y), which is orthogonal to the $\langle 111 \rangle$ crystal axis. Each animation shows the deflected beam distribution vs. penetration depth for each frame. The red lines represent the three (110) atomic planes. Animations 1 and 2 are for the crystals with bending radii $R_1 = 30.3\ m$ and $R_2 = 6.9\ m$, respectively.

Three frames of the animations at different beam penetration depths (L), i.e., $L = 0, 1, 2\ mm$, are displayed in Fig. 1 for both R_1 (plots a, b, c) and R_2 (plots d, e, f).

A direct comparison of the two animations highlights that, at the first steps inside the crystal, most of the particles are stochastically deflected in the horizontal plane for both the crystals, while the relaxation to planar channeling in the planes intercepting the axes is more effective for crystal 2. Indeed, in this second case, after the first half of the crystal, practically all the particles left the axial region, being then captured by the planar potential wells.